

REMARKS

Reconsideration and allowance of the above-referenced application are respectfully requested.

The present application relates to a method for producing a hard mask for a capacitor device. The hard mask is formed in fewer steps than conventional methods using a photosensitive sol-gel layer. The sol-gel layer is applied to the capacitor device. The sol-gel layer is patterned. A nitrogen thermal decomposition treatment is applied to the patterned layer to convert it to a hard mask layer comprising a metal nitride. The hard mask layer may then be etched according to the applied pattern.

Claims 1-7, 12 to 14, 18 and 19 are directed to the above method. Claim 15 is directed to a ferroelectric capacitor device etched according to this method. Claim 16 is directed to a FeRAM device etched according to this method, and Claim 17 is directed to a hard mask formed according to the method.

New claims 18 and 19 are added. Support for these claims can be found at page 5, second paragraph.

The examiner has raised new prior art in this, the third office action on the application.

The new prior art cited is Uchida, Patent No. 6,051,858 issued 18 April 2000. The issue date is significantly before the filing date of this patent application and we therefore cannot understand why the citation was not raised in either of

the earlier two office actions when the claims have not been amended in a substantive manner. Such piecemeal examination is to be regretted.

We further note that the present application is a method for producing a hard mask in a capacitor device and a hard mask for use in a capacitor device. It is placed in international class G03F7/00 and US class 430/322. Additional search classes are 430/320 and 430/330. When one considers the citation, it is for a ferroelectric/high dielectric constant integrated circuit and method of fabricating it. It is in international class H01L29/76 and US class 257/295. Additional US classes are in 257/296. The search classes are extended to 427/533, 106/287.18. None of the search classes for Uchida include the present application classes. We further note that the Maloney citation, also relied upon, is also international class H01L35/24. That class is more closely related to the classes of Uchida than the present application.

When one considers Uchida, there is considerable disclosure of a photosensitive layer. However, in Uchida, the purpose of the photosensitive layer is for the formation of a dielectric/ferroelectric layer 106 or protective layer 40. The dielectric/ferroelectric layer 106 is not a capacitor device to which the hard mask is applied. So Uchida discloses the use of a hard mask for something quite different to that of the claimed invention. It is not the application of a hard mask on a

capacitor device. In Uchida, the relevant description starts at column 14, line 46 and continues until column 23, line 8.

When one considers the disclosure of the citation, it is specifically for FeRAM. It is a method of manufacturing a transistor-on-silicon with a capacitor layer 34 (Figure 5). The transistor-on-silicon is manufactured using a substrate 20 and applying a field oxide layer 23 on the substrate 20. Gate oxide 27 is applied to field oxide layer 23. The doped active areas 24 and 25 are formed on the gate oxide 27. Active regions 24, 25 are preferably p-type materials. Ohmic contacts 29A, 29B and 29C are then formed. A further dielectric layer 31 is then deposited by, for example, spin-on-glass. A well 37 is then formed and a conductive plug 38 is formed in well 37. The conductive plug 38 may be of, for example, polysilicon or tungsten.

A capacitor 30 is formed on the dielectric layer 31 and plug 30. The capacitor 30 has a bottom electrode 32, a ferroelectric/dielectric layer 34, and a top electrode 36.

A protective layer 40 is then applied. The process for forming the protective layer 40 is described at column 28, line 65 to column 30, line 50. Reference to forming a protective sacrificial layer 40 is also made at column 15 lines 47 and 48.

In Uchida there is no disclosure of a method for producing a hard mask **on** a **capacitor** device. As such, Uchida is not an anticipation of the claimed invention. See column 8, lines 45 to

48 and 55 to 61 where it is specifically stated that "...a mask...may be omitted...". Therefore, Uchida discloses and teaches the exact opposite of the claimed invention.

One only has to consider the very large number of steps involved in the process described from column 15 line 43 to column 28 line 65 to realize that the present invention as claimed has clearly provided a much simpler process. The Uchida process is to prepare a photosensitive solution used to make a layered superlattice material. The photosensitive solution is preferably used to form the ferroelectric layer of a ferroelectric capacitor. The ferroelectric capacitor has a bottom electrode 104, a dielectric or ferroelectric material 106, and a top electrode 108.

At column 14 lines 57 to 67 are given three categories of the photosensitive solution. The third is an o-nitrobenzyl alcohol in a sol-gel solution. Four examples of a photosensitive solution are then given. The description of the process continues at column 18 line 50. The photosensitive solution is applied to the substrate 105 as a thin film. The substrate 105 comprises an insulating layer 102 and a bottom electrode 104 on which the dielectric or ferroelectric material 106 is formed. The thin film of photosensitive liquid solution is pre-baked on a hot plate in air to stabilize the thin film of photosensitive liquid solution. A mask is then aligned with the substrate 105 and the dried thin film of photosensitive liquid solution is

exposed to ultraviolet radiation to initiate a **polymerization** reaction to gel or harden the thin film of photosensitive liquid solution in those areas exposed to the ultraviolet radiation.

Post-baking then follows to stabilize the thin film of photosensitive liquid solution. Washing or rinsing with an apolar developer solution then follows to remove the unpolymerized thin film of photosensitive liquid solution. The developed thin film of photosensitive liquid solution is treated to form a solid film of the desired metal oxide. The treatment may be: exposure to vacuum, exposure to ultraviolet radiation, drying, heating, baking, and annealing.

The process may be repeated until the thin film of photosensitive liquid solution has reached the desired thickness.

In Uchida at column 29 line 60 to 64, there is described the process:

"The spinning, pre-bake, UV irradiation, post-bake, development, dry, repeat step 214, and anneal parameters were as described in Example 5".

Uchida does not disclose applying a photosensitive sol-gel layer **to** a capacitor device.

Uchida does not disclose applying a **nitrogen thermal decomposition treatment** to the patterned sol-gel layer to convert the patterned sol-gel layer to a hard mask layer comprising a metal nitride.

We must strongly submit that Uchida does not disclose the invention as claimed.

We must strongly submit that the invention as claimed is novel over Uchida.

We most strongly submit that the invention as claimed is not obvious over Uchida.

We also most strongly submit that a person of ordinary skill in the art would not consider Uchida because it is not directed at the same technology. It is not even for an analogous technology. A similar comment applies to Maloney. A person seeking to solve the problem addressed by the present invention would not consider Uchida or Maloney, or both of them, as:

- their disclosures are not directed at solving the same problem;
- their processes are so complex compared to the processes as claimed in the present application that they teach away from the present invention; and;
- they are in such unrelated classes that a skilled searcher would not locate them.

We therefore most strongly submit that the objections should be withdrawn and the application be able to proceed to allowance.


It is believed that all of the pending claims have been addressed in this paper. However, failure to address a specific

rejection, issue or comment, does not signify agreement with or concession of that rejection, issue or comment. In addition, because the arguments made above are not intended to be exhaustive, there may be reasons for patentability of any or all pending claims (or other claims) that have not been expressed. Finally, nothing in this paper should be construed as an intent to concede any issue with regard to any claim, except as specifically stated in this paper, and the amendment of any claim does not necessarily signify concession of unpatentability of the claim prior to its amendment.

Applicant asks that all claims be allowed. No fee is believed to be due, however please apply any applicable charges or credits to Deposit Account No. 06-1050.

Respectfully submitted,

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